

INDOOR AIR QUALITY ASSESSMENT

**White Brook Middle School
200 Park Street
Easthampton, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of Dennis LaCourse, Health Agent of the Easthampton Board of Health and a parent, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the White Brook Middle School (WBMS), 200 Park Street, Easthampton, Massachusetts. Concerns about indoor air quality were raised by parents and faculty.

On November 22, 2002, a visit was made to this school by Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. Mr. Feeney was accompanied during this evaluation by Mr. LaCourse.

The school is a one story, red brick, multi-wing facility constructed in 1976. The building contains general classrooms, art rooms, science classrooms, library, auditorium, pool, and main office area. Most classrooms were arranged in a “pod” system, with a large open room divided by a combination of six-foot high shelves as well as floor-to-ceiling foldable curtains. Classroom areas along exterior walls have openable windows. No openable windows exist in the library.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

This school has a student population of approximately 610 and a staff of approximately 72. The tests were taken during normal operations at the school. Test results appear in Tables 1-7.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 ppm (parts per million) in twenty-six of sixty-one areas surveyed, which is indicative of a ventilation problem in these areas of the school. It is also noted that a number of areas with carbon dioxide levels below 800 ppm were areas that had open windows, low population or were of a large area (e.g., auditorium). Each of these conditions can greatly reduce carbon dioxide levels. Please note that class areas in the 500 wing had consistently elevated carbon dioxide levels with increased continuous occupancy. Other areas of the WBMS would be expected to produce similar carbon dioxide results under similar conditions of occupancy.

A heating, ventilation and air conditioning (HVAC) system provides ventilation. Fresh air is provided by rooftop-mounted AHUs (see Picture 1). These AHUs are connected to ducts that supply fresh air to rooms through ceiling mounted air diffusers (see Picture 2). By design, air diffusers are equipped with fixed louvers, which direct the air supply along the ceiling to flow down the walls, creating airflow.

Exhaust ventilation is provided by infiltration of air into an above ceiling open return plenum, which returns air to the AHUs. This system has no ductwork, but uses the entire above ceiling space to draw air back to the AHU.

In order to have proper ventilation with a mechanical supply and exhaust system, these systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. According to school department officials, the date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time

weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please consult [Appendix I](#).

Temperature readings ranged from 69° F to 74° F, which were within (or very close) to the BEHA recommended range. The BEHA recommends that indoor air temperatures be maintained in a range between 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in the building ranged from 34 to 46 percent, which is below the BEHA recommended comfort range. The one exception was the pool area, which measured 65% relative humidity. The BEHA recommends a comfort range of 40-60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Water penetration was noted through the exterior doorframes of the 500 wing class areas (see Pictures 3 and 4). Similar damage to exterior wall doorframes was noted in other areas of the building. Of note was carpeting in class areas, which was installed against the threshold of exterior doors. Water damage to the doorframes indicates that wall-to-wall carpet installed around the threshold may become regularly moistened, most likely during wind-driven rain or drifting snow. Roof/shelter systems exist over exterior doors. Rainwater collecting on the exterior walls rolls off the wall to the base of the exterior to collect and drain from the building. This design is problematic due to tarmac/cement slabs used as exterior door thresholds. Splashing rainwater can lead to chronic moistening of the exterior wall and doors, which in turn moistens carpet installed against the doorframe. Mold colonization of the carpet can occur from repeated moistening due to driving rain/melting snow. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Water-damaged carpeting cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy carpeting is not recommended.

A number of areas have water-damaged ceiling tiles which can indicate leaks from either the roof or plumbing system. One leak over vending machines appears to be a chronic problem. An examination of the roof found a section of roof lower than the majority, which creates a small vertical section of brick wall within the roof (see Picture 5). Spaces in roof flashing seams in brick and mortar joints were noted in this

wall (see Pictures 5 and 6). The spaces in the roof wall correspond to a leak noted above the vending machines.

Two private reading rooms located within the library had a musty odor. These rooms had water damaged/mold colonized acoustical tiles and damaged plywood. Replacement of these ceiling tiles is difficult, since their removal appears to necessitate the destruction of the tile, which can result in the aerosolization of particulates. Ceiling tiles, acoustical tiles and plywood are porous materials that can serve as mold growth media if moistened repeatedly.

Several areas had a number of plants. The library had a plant located on top of wall-to-wall carpeting. The planter can be a source of moisture that can chronically moisten carpet and lead to mold growth. Plant soil and drip pans can serve as a source of mold growth. A number of these plants did not have drip pans. Plants should be properly maintained and be equipped with drip pans. Plants should also be located away from the air stream of mechanical ventilation to prevent aerosolization of dirt, pollen or mold.

Several classrooms have sinks that had an open seam between the countertop and wall. If not watertight water penetration through this seam can result. Several sinks in the science wing have shifted, opening a space between the counter and sink (see Picture 7). Water penetration and chronic exposure to water on wood and plywood can cause these materials to swell and serve as growth media for mold.

Pools of standing water and accumulated debris (e.g., leaves) were noted in a number of areas on the roof (see Picture 8). The collection of water and the subsequent freezing and thawing during winter months can lead to roof leaks and water penetration

into the interior of the building. In addition, AHU condensation drains are located directly over pooling water (see Picture 9). Condensation drains are frequently placed in an area of the AHU cabinet that draws air into the cabinet when no water is in the pipes during the heating season. This configuration can result in moisture and odors from pooling water to be drawn into the AHU. Pooling water can also become stagnant, which can lead to mold and bacterial growth, give off unpleasant odors and provide a breeding ground for mosquitoes.

Shrubbery in direct contact with the exterior wall brick was noted in several areas around the building (see Picture 10). Shrubbery can serve as a possible source of water impingement on the exterior curtain wall due to the location of plants growing directly against the building. In addition, the growth of roots against the exterior walls can bring moisture in contact with wall brick and eventually lead to cracks and/or fissures in the foundation below ground level. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building through capillary action through foundation concrete and masonry (Lstiburek, J. & Brennan, T.; 2001).

Other Concerns

Several other conditions were noted during the assessment, which can affect indoor air quality. A number of the science classrooms have chemical hoods equipped with sinks (see Picture 11). It is likely that these drains have dry traps, which can allow sewer gas to back up into classrooms. In addition, several unused dishwashers were noted in science classrooms. Each of the appliances will empty water into drains, which

also should have traps. Without use, these traps can also dry out, resulting in sewer gas backup in the line. Sewer gas can be irritating to the eyes and nose.

The science classrooms have large horticultural cabinets (see Picture 12) and display shelves (see Picture 13) that are connected to exhaust vents. Each of these units is unused and the exhaust vents appear to be inactive. Inactive exhaust vents open to the outdoors can serve as a means of drafts and allow water vapor to penetrate into the building. Abandoned exhaust ventilation equipment should have the exhaust vent rendered air and water tight to prevent moisture from breaching the building envelope, subsequently leading to uncontrolled drafts and water penetration.

A number of classrooms contained upholstered furniture. Upholstered furniture is covered with fabric that comes in contact with human skin. This type of contact can leave oils, perspiration, hair and skin cells. Dust mites feed upon human skin cells and excrete waste products that contain allergens. In addition, if relative humidity levels increase above 60 percent, dust mites tend to proliferate (US EPA, 1992). In order to remove dust mites and other pollutants, frequent vacuuming of upholstered furniture is recommended (Berry, M.A., 1994). It is also recommended that upholstered furniture (if present in schools), be professionally cleaned on an annual basis. If an excessive dusty environment exists due outdoor conditions or indoor activities (e.g., renovations), cleaning frequency should be increased (every six months) (IICR, 2000). Elevated outdoor levels of airborne particulates can result in increased levels of indoor particulates by entering into the building through open windows, doors and filter bypass.

Wall cracks, spaces around windows and missing/dislodged ceiling tiles were noted in a number of classrooms throughout the building. In addition to being a source

for water penetration, these areas are breaches of the building envelope, which can serve as an egress for vapors, fumes, dusts, and other odors between rooms and floors.

A sewer gas vent pipe on the roof was found in close proximity to the fresh air intake located near the AHU (see Picture 14). Sewer gas vent pipes are recommended to be at least ten feet away from ventilation fresh air intakes (SBBRS, 1997; BOCA, 1993). If the plumbing vent is located within ten feet of a fresh air supply intake, the pipe should be extended 2 feet (at a minimum) above the mechanical system intake (SBBRS, 1997; BOCA, 1993) to avoid entrainment of sewer gas odors into the HVAC system.

Of note were reports of repeated ant infestation around the building, in and around exterior doors. Stored food containers were noted in some classrooms. In addition, one classroom had student art projects that were made from food. Each of these circumstances can create conditions to attract pests such as ants into the building. Under current Massachusetts law (effective November 1, 2001) the principles of integrated pest management (IPM) must be used to remove pests in state buildings (Mass Act, 2000). Pesticide use indoors can introduce chemicals into the indoor environment that can be sources of eye, nose and throat irritation. The reduction/elimination of pathways/food sources that are attracting these insects should be the first step taken to prevent or eliminate this infestation.

Located in the planning room are a number of photocopying machines. No local exhaust ventilation for the photocopiers exists. A single plastic grill in the ceiling serves as the return vent for this area. Of note is that at least one printer (Risograph[®]) uses a liquid toner. Photocopiers can also produce volatile organic compounds (VOCs) and ozone, particularly if the equipment is older and in frequent use. VOCs and ozone are

respiratory irritants (Schmidt Etkin, D., 1992). It is recommended that local separate exhaust systems that do not recirculate into the general ventilation system be used.

Of note is the use of individually purchased cleaning materials in the building. Cleaning materials frequently contain ammonium compounds or sodium hypochlorite (bleach-products), which are alkaline materials. Volatile organic compound (VOC) containing materials, such as paints, paint thinners, turpentine (see Picture 15), furniture polish, spray paints, and other materials were found in a number of areas. The use of these products can provide exposure opportunities for individuals to a number of chemicals, which can lead to irritation of the eyes, nose or respiratory tract. In all of these instances, cleaning products containing respiratory and skin irritants appear to be used throughout the building.

Concerns were raised about a proposed renovation project to remove the current moveable wall/curtains (see Picture 16) and replace with permanent walls. If the proposed walls can be built and affixed to the building frame at the current height of the moveable wall/curtains, this alteration would be expected to have minimal impact of air distribution in classrooms. If the proposed replacement walls must penetrate through the ceiling tile system to be affixed to roof trusses or support beams, this alteration may have a distinct negative impact on air distribution. The building appears to use a ceiling plenum system instead of ductwork to return classroom air back to the rooftop AHUs. In effect, the entire space of the ceiling system serves in place of ducts to remove air from classrooms. An indicator of this design is the inclusion of a window frame system that allows for radiant heating (from the sun), to heat air in the plenum (see Picture 17), presumably as an energy conservation measure. If walls are installed through the ceiling,

the additional wall space can serve to create dead spaces and possibly air pockets that would be expected to degrade the operation of the existing ventilation system. Careful consideration should be given concerning any alteration to the ceiling plenum, since air monitoring conducted by BEHA staff indicated ventilation problems with the existing HVAC system.

Conclusions/Recommendations

The conditions noted at the WBMS raise a number of indoor air quality issues. The combination of the general building conditions, maintenance, design and the operation of HVAC equipment, if considered individually, present conditions that could degrade indoor air quality. When combined, these conditions can serve to further negatively affect indoor air quality. Some of these conditions can be remedied by actions of building occupants. Other remediation efforts will require alteration to the building structure and equipment. For these reasons a two-phase approach is required, consisting of **short-term** measures to improve air quality and **long-term** measures that will require planning and resources to adequately address the overall indoor air quality concerns.

The following **short-term** measures should be considered for implementation:

1. Remove carpeting up to three feet from the threshold of exterior doors. Replace carpeting with a non-slip, nonporous material (e.g., rubber matting, tile, etc.).
2. Examine each AHU, fresh air diffuser and exhaust vent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each

room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers.

3. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994). Consult a ventilation engineer concerning re-balancing of the ventilation systems.
4. Examine the feasibility of increasing HVAC filter efficiency. Ensure that filters are of a proper size and installed in a manner to eliminate particle bypass of the filter. Note that prior to any increase of filtration, each unit should be evaluated by a ventilation engineer as to whether they can maintain function with more efficient filters.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Consider sealing the condensation drains for AHUs during the heating season. Please note that drains must be unsealed during the air-conditioning season in order to serve their intended purpose (i.e., to drain condensation. **Failure to remove condensation drain seals can result in water back up into the AHU and produce mold growth.**
7. Remove foliage to a minimum of five feet away from the foundation.
8. Repair seams between sink countertops and splashboard.
9. Remove debris from roof.

10. Move plants away from univents in classrooms. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.
11. Remove plants from library carpet.
12. Examine the feasibility of improving drainage on roof.
13. Repair cracks in vertical walls on roof.
14. Store flammable materials in flameproof cabinets consistent with local and state fire codes.
15. Clean upholstered furniture on the schedule recommended in this report. If not possible/practical, remove upholstered furniture from classrooms.
16. It is highly recommended that the principles of integrated pest management (IPM) be used to rid this building of pests. A copy of the IPM recommendations can be downloaded from the Internet at

http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf
17. Replace missing ceiling tiles, to improve exhaust ventilation and prevent the egress of dirt, dust and particulate matter into classrooms.
18. Determine whether science wing chemical hoods, horticultural cabinets, vent display cases and dishwashers will be used. Consider sealing vents at rooftop and classroom levels. Consider removing dishwashers and sealing drains. Consider sealing chemical hood drains and disconnecting water supply.
19. Examine the feasibility of providing local exhaust ventilation for the photocopier room or relocate equipment to an area with adequate exhaust ventilation.
20. Consider relocating or extending sewer gas pipes at least 10 feet above fresh air intakes located on the roof.

21. Reduce the use of cleaning materials that contain respiratory irritants (ammonia related compounds) on floors and in classrooms. Do not use these materials to disinfect equipment that comes into close human contact (e.g., telephones). Substitute plain soap and hot water for ammonia related cleaning products. Cleaning products that contain ammonia should only be used where necessary. If ammonia containing cleaning products is used, rinse the area of application with water to remove residue.

The following **long-term measures** should be considered:

1. Have a ventilation engineer examine the potential impact of altering the ceiling plenum if interior walls are installed through the suspended ceiling.
2. Water-damaged ceiling tiles should be replaced. These ceiling tiles can be a source of microbial growth and should be removed. Source of water leaks (e.g., window frames and roof) should be identified and repaired. Examine the non-porous surface beneath the removed ceiling tiles and disinfect with an appropriate antimicrobial.
3. Consider replacing the countertop over the water-damaged cabinets. Consider using molded countertops to minimize seams where water and dirt can accumulate, thereby decreasing the chance of mold growth.
4. In order to maintain a good indoor air quality environment on the building, consideration should be given to adopting the US EPA document, "Tools for Schools", which can be downloaded from the Internet at <http://www.epa.gov/iaq/schools/index.html>.

5. For further building-wide evaluations and advice on maintaining public buildings, see the resource manual and other related indoor air quality documents located on the MDPH's website at <http://www.state.ma.us/dph/beh/iaq/iaqhome.htm>.

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Picture 1



Rooftop AHUs

Picture 2



Ceiling Mounted Fresh Air Diffuser

Picture 3



Water Penetration through Door Frame

Picture 4



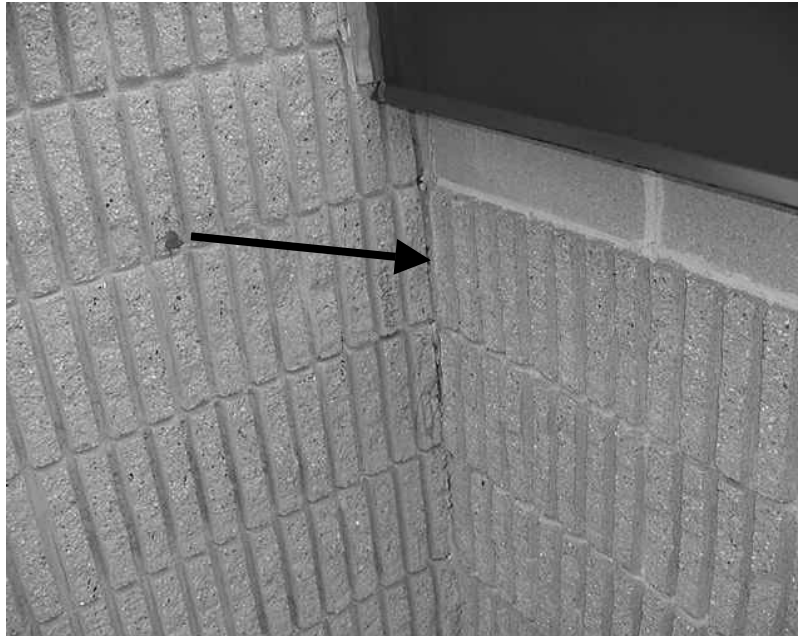
Water Penetration through Door Frame, Note Corrosion at Base of Door and Rust Stain on Carpet

Picture 5



Vertical Wall on Roof, Note Accumulated Debris

Picture 6



Vertical Wall on Roof, Note Cracks along Seams

Picture 7



Seam between Sink and Counter

Picture 8



Pooling Water on Roof, Note Contact of Water with Vent

Picture 9



Pooling Water on Roof below Condensation Drain of AHU

Picture 10



Shrubbery In Contact With Exterior Wall

Picture 11



Unused Chemical Hoods with Sinks

Picture 12



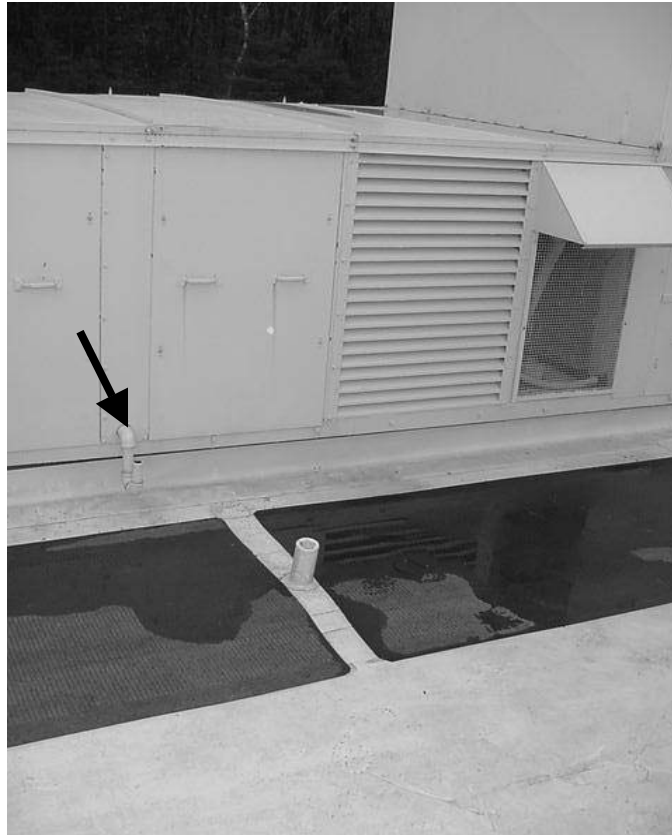
Unused Horticultural Cabinets

Picture 13



Exhaust Vented Display Cabinets (Arrow Indicates Exhaust Vent)

Picture 14



Sewer Gas Vent Pipe on the Roof in Close Proximity to AHU Fresh Air Intake, Note Condensation Drain

Picture 15



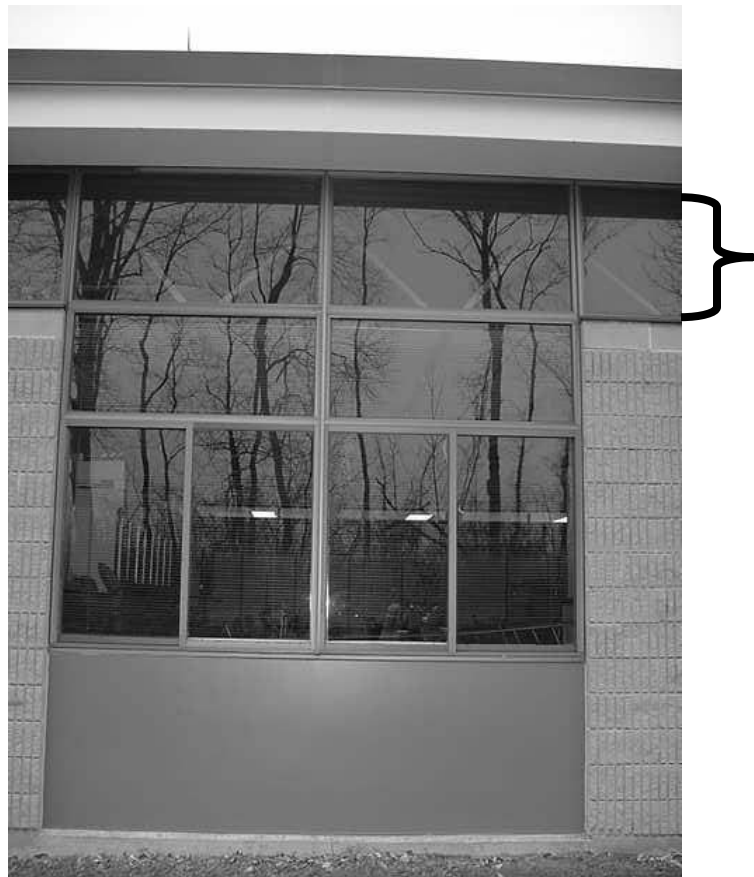
Paint Thinners and Turpentine Stored in a Metal Cabinet

Picture 16



Moveable Current Separating Pods into Class Areas

Picture 17



Glass Windows Exposing the Ceiling Plenum to Radiant Heat, Note Trusses

TABLE 1

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	338	40	87					
Room 607	460	74	35	0	Y	Y	Y	CT 2 bio cabinet Dry drain trap
Room 603	570	71	35	0	N	Y	Y	Kiln not used Clay mixer
Room 611/612	479	70	35	0	N	Y	Y	
Room 637	671	71	38	24	N	Y	Y	Door open
Room 636	664	71	38	14	Y	Y	Y	Coke bottles Water-damaged carpet
Room 635	850	72	38	27	Y	Y	Y	Water-damaged carpet
Room 634	809	72	39	25	Y	Y	Y	Water-damaged carpet
Room 633	701	72	38	1	Y	Y	Y	Water-damaged carpet
Room 632	650	72	37	0	Y	Y	Y	Plants

* ppm = parts per million parts of air
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 631	645	72	37	18	N	Y	Y	
Room 630	651	71	37	0	N	Y	Y	
Room 602	615	72	38	7	N	Y	Y	CT 4 broken/leak Door open
Room 521	932	69	45	12	N	Y	Y	CT 7 Door open
Room 522	1266	71	46	19	N	Y	Y	Door open
Room 523	1245	72	45	4	N	Y	Y	Door open
Room 524	1288	73	41	17	Y	Y	Y	Door open
Room 525	1674	72	41	15	Y	Y	Y	Water-damaged carpet
Room 526	1126	72	39	18	Y	Y	Y	Water-damaged carpet Door open
Room 527	1105	73	38	6	N	Y	Y	Door open

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CT = water-damaged ceiling tiles

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TABLE 3

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Maintenance 505	390	74	38	2	Y	Y	Y	Spray booth – hole Space above wall
Room 508	739	71	36	20	N	Y	Y	Chemical hood
Room 509	658	71	36	1	Y	Y	Y	Sink
Room 510	686	72	37	0	Y	Y	Y	Sink – dry trap
Room 507	643	71	36	0	N	Y	Y	Lab Line
Art Supply								Food on -----
Room 511	830	69	42	21	N	Y	Y	Outside door broken
Room 537	884	70	42	27	N	Y	Y	
Room 534	906	71	41	21	Y	Y	Y	Outdoor door broken Water-damaged carpet
Room 535	1104	72	42	20	Y	Y	Y	Water-damaged carpet

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TABLE 4

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 536	995	72	41	23	Y	Y	Y	Water-damaged carpet
Room 533	923	72	40	11	N	Y	Y	Water-damaged carpet
Room 532	946	71	40	9	Y	Y	Y	Water-damaged carpet
Room 531	892	71	39	0	N	Y	Y	
Room 520	847	72	38	3	N	Y	Y	Chalk ---Art
Room 502	888	72	39	1	N	Y	Y	Water-damaged sink – dishwasher
Room 621	766	72	35	10	N	Y	Y	Water-damaged carpet
Room 622	894	72	36	17	Y	Y	Y	
Room 623	854	71	36	14	N	Y	Y	Water-damaged carpet
Room 624	849	72	37	22	Y	Y	Y	Water-damaged carpet Food cans

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TABLE 5

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 625	854	72	37	19	Y	Y	Y	Water-damaged carpet
Room 626	935	72	38	25	Y	Y	Y	Water-damaged carpet
Room 627	860	72	37	23	N	Y	Y	Plants
Room 620	800	72	37	0	N	Y	Y	
Room 608	427	69	36	1	N	Y	Y	Chemical hood –sink CT 1
Room 609	53	71	37	25	Y	Y	Y	
Band Room	513	70	37	0	N	Y	Y	Exhaust on
TV Studio	425	71	36	1	N	Y	Y	Exhaust on, water-damaged plaster Cleaners under sink, bleach, furniture polish
A---	371	73	34	0	N	Y	Y	Exhaust on
Room 409	732	72	36	5	N	Y	Y	

* ppm = parts per million parts of air
CT = water-damaged ceiling tiles

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TABLE 6

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Planning Room		74	35	0	N	Y	Y	Exhaust on
Room 401	747	74	35	0	N	Y	Y	Exhaust on
Room 404	706	73	35	4	N	Y	Y	Exhaust on Water-damaged cabinet
Library	688	72	35	21	N	Y	Y	Plants on carpet
Resource Library	723	72	34	0	N	Y	Y	
Room 402	755	73	37	2	N	Y	Y	Undercut door
Room 403-A	795	74	36	4	N	Y	Y	
Medical ----?					N	N	N	Mold odor on carpet
Room 407	749	73	36	25	N	Y	Y	26 computers door open
Room 406	722	72	36	8	N	Y	Y	CT 1, door open 28 computers

* ppm = parts per million parts of air
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 7

Indoor Air Test Results – Easthampton White Brook Middle School

Date: 11/22/02

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 418	666	71	37	0	N	Y	Y	Upholstered furniture Nail polish remover
Room 417	745	72	38	1	N	Y	Y	Drain cleaner under sink
Div. of Food Serv	657	73	35	2	N	Y	Y	Door open
Pool	671	70	65	22	N	Y	Y	

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